(No Model.) 2 Sheets—Sheet 1.

E. WALSH, Jr.

PROCESS OF REDUCING ZINC ORES.

No. 364,979. Patented June 14, 1887.

Fig. 1.

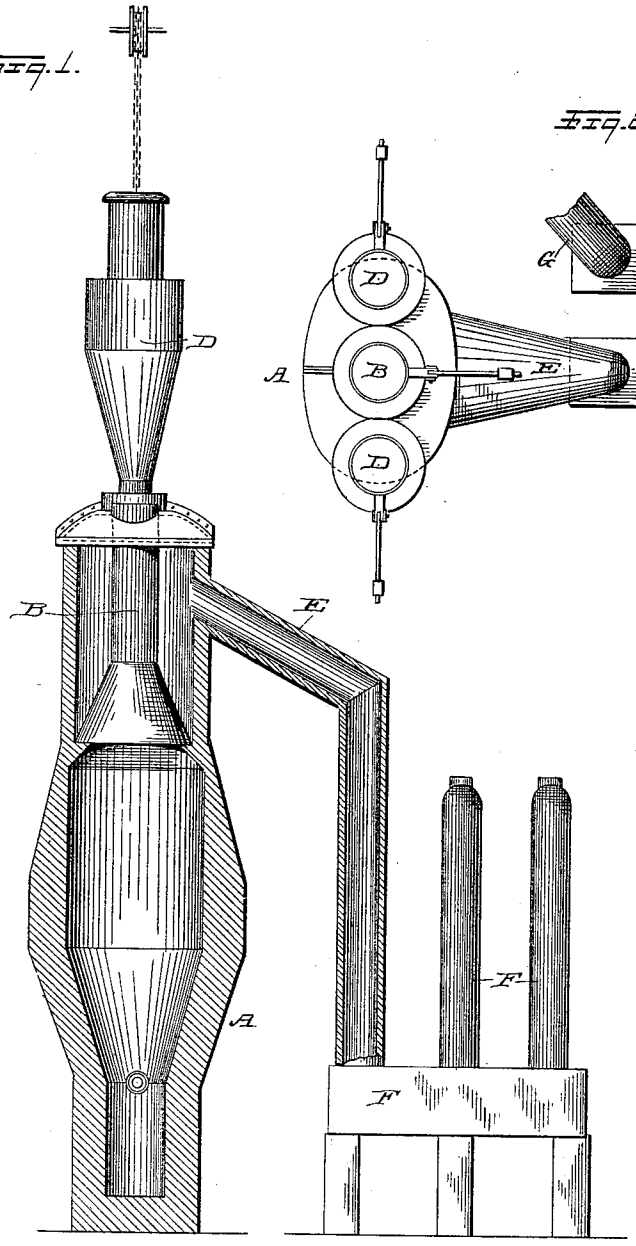

Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

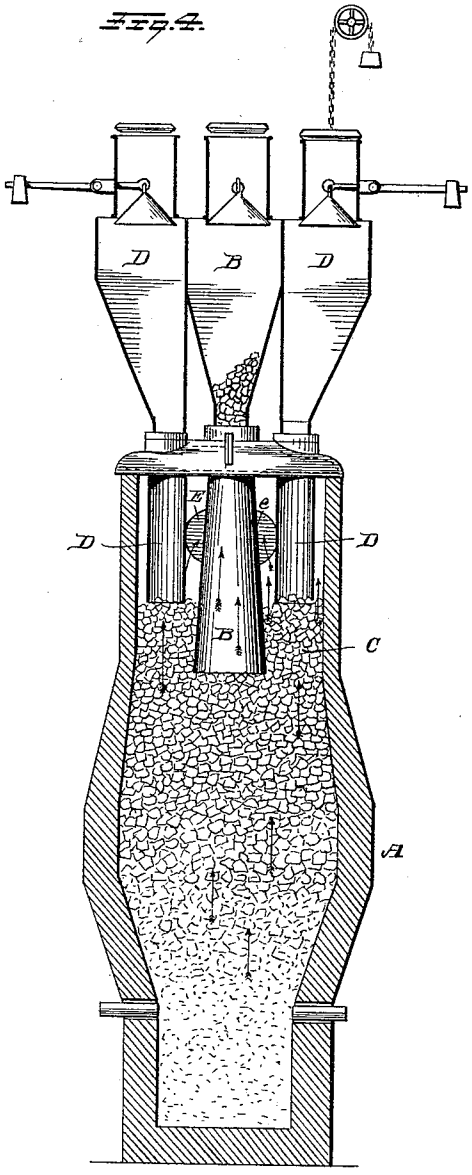
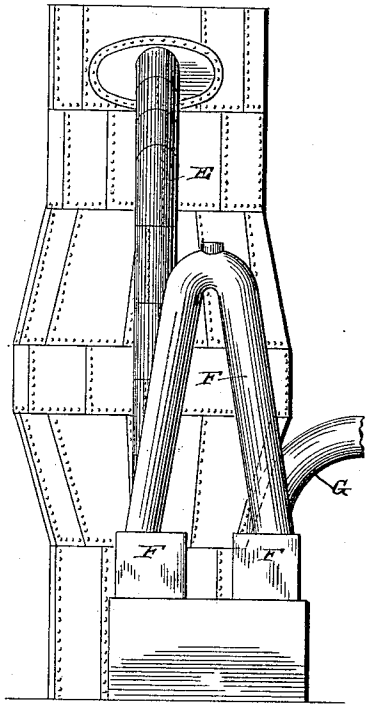


Fig. 3.



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UNITED STATES PATENT OFFICE.

EDWARD WALSH, JR., OF ST. LOUIS, MISSOURI.

PROCESS OF REDUCING ZINC ORES.

SPECIFICATION forming part of Letters Patent No. 364,979, dated June 14, 1887.

Application filed April 16, 1886. Serial No. 199,149. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WALSH, Jr., a citizen of the United States, residing in the city of St. Louis, State of Missouri, have made a certain new and useful discovery in the art relative to the reduction of the oxide of zinc in native or calcined zinc ores, of which the following is a full, clear, and exact description.

Oxide of zinc is ordinarily obtained from the natural zinc ore by three processes—the Belgian, the Silesian, and the English—the last of which is nearly obsolete. The Belgian and Silesian have the same general manner of accomplishing the result, and the choice of one or the other depends upon local circumstances—viz., prices of fuel, class of ore, and also the amount of metallic zinc contained in the ores. They both use small retorts, cylindrical in shape, heated externally either by a Siemens gas-furnace or hand-fired furnace. Into the retorts is charged the mixture of calcined ores and fuel, and the distilled zinc is collected or condensed in the prolongation of the retort, which is firmly luted onto the end of the retort outside of the furnace. These processes are very wasteful and very laborious; but the processes which I have stated above are those which are in universal use today, notwithstanding the great expense and waste connected with them.

I am aware that attempts have been made to treat zinc ores in a blast or cupola furnace, my attention having been called to United States Letters Patent to Adrian Muller, No. 32,840, dated July 16, 1861, and United States Letters Patent to Amedee G. Sebillot, No. 291,410, of January 1, 1884; but in practice the devices described in the said several Letters Patent will be found not to be operative for the purpose of reducing oxide of zinc in ores, the conditions appertaining to a blast or cupola furnace and the temperatures at which the various reactions take place not having been provided for.

In regard to the Muller patent, the inventor describes, as one step in his process, the molding of materials into blocks, &c. This is an unnecessary expense and is detrimental to the process, inasmuch as it interferes with the proper combustion of the fuel as it approaches the tuyeres; and, furthermore, in order to agglomerate the materials, it would be necessary to crush the fuel, and the universal experience with the blast-furnace or cupola-furnace has shown that powdered fuel does not give good action in the furnace. Furthermore, the introduction of carbonic oxide about the middle of the furnace, as stated by Muller in his specification, not only is an expensive thing to do by the means set forth, but it is a positive disadvantage. It only tends to interfere with the action of the blowing apparatus, and can have no effect in promoting a downward tendency of the vapor, inasmuch as, after deducting the friction of its passage through a long conduit, and a diminishing pressure, due to partial escape of the gases from the condenser, its pressure will be so greatly diminished that, instead of retarding the upward flow or driving down the vapors, it will afford an upward passage for the vapor thereby seriously interfering with the process. Another serious objection to this method of Mr. Muller's is that at the level at which the gases are withdrawn the numerous openings form a means of very rapidly destroying this portion of the furnace. In fact, it would be impossible to find material sufficiently refractory to withstand the intense heat at the point of the furnace at which he withdraws his gases.

Mr. Sebillot, in his patent above referred to, has not solved the problem of manufacturing metallic zinc in a blast or cupola furnace, for reasons which will more clearly appear in describing my invention. It is true, as he states, that attempts in this direction have heretofore been a failure, as the vapors of zinc are immediately converted into oxide of zinc by the very smallest quantity of carbonic acid; but he does not describe an apparatus which will convey clean vapors of zinc into the condenser, free from carbonic acid. His lower eduction-orifices, as stated by him, are situated in the very hottest part of the furnace, at a point where the temperature would be about 3,000° Fahrenheit. This temperature is so great that it will destroy the arrangement of devices which he has provided for keeping the "charcoal G at a red heat." As will be appreciated from reading a description of my invention, his lower eduction-orifice is at an unnecessarily low point in the furnace and at a point at which it would be a practical impossibility

for the operation which he described to take place. This shows that the conditions pertaining to a blast-furnace are not appreciated by the inventor, and that the question of temperatures at which the various reactions take place (essential features guarded against and provided for in my invention) was not considered by him. Furthermore, in the furnace described by Mr. Sebillot the zinc ore charged in the top of the furnace will of necessity be reduced and volatilized in the higher and cooler portions of the furnace, and the zinc will be oxidized in these higher and cooler portions of the furnace by the atmospheric air, and the moisture contained in the fuel and the carbonic acid generated in the reduction of the zinc oxide will be carried into the upper eduction-orifice or outlet-pipe and into the condenser.

In my invention the conditions pertaining to a blast or cupola furnace and the degrees of temperature at which the various reactions take place are considered. Zinc oxide reduces at 1,300° Fahrenheit, and the metal distills at about 100° Fahrenheit lower than that temperature. Volatilization takes place immediately on reduction of the zinc oxide. At a temperature of 1,300° Fahrenheit carbon is entirely unaffected by the action of carbonic acid, and the carbonic acid generated from the reduction of the zinc oxide is carried off with the zinc vapor at that temperature. Carbonic acid at a temperature below 1,300° Fahrenheit, when mixed with zinc vapor again oxidizes the metallic zinc vapor, thereby producing an undesirable result; but I have discovered that when zinc vapor and carbonic acid, both at a temperature of between 1,400° Fahrenheit and 1,500° Fahrenheit, or slightly in excess of that temperature, are allowed to pass through carbon or carbonaceous matter, which is also at a temperature of between 1,400° Fahrenheit and 1,500° Fahrenheit, the carbonic acid is immediately converted into carbonic oxide, and that thus the zinc vapor does not undergo any further oxidation; that the result of thus allowing carbonic acid and zinc vapor at the temperature of between 1,400° Fahrenheit and 1,500° Fahrenheit, or slightly in excess of that temperature, to pass through carbon or carbonaceous matter at a temperature between 1,400° Fahrenheit and 1,500° Fahrenheit, or slightly in excess of that temperature, is to produce zinc vapor and carbonic oxide. I have utilized this discovery of the various temperatures at which these reactions take place, together with my knowledge of the conditions pertaining to furnaces, so as to reduce metallic zinc in cupola-furnaces.

I utilize a cupola-furnace of special design for the purpose, as illustrated by the accompanying drawings, on which—

Figure 1, Sheet 1, is a sectional elevation of the furnace and its appurtenances; Fig. 2, Sheet 1, a plan thereof, and Fig. 3, Sheet 2, an end view thereof with top portions removed; Fig. 4, Sheet 2, a sectional elevation of the furnace on a plane at right angles to that in Fig. 1, and charged with fuel and ores.

In the drawings, A represents the furnace, into which the fuel and calcined zinc ores, mixed in such proportions that sufficient fuel is present to effect a reduction of the zinc oxide to volatilize the zinc and fuse the properly-fluxed impurities contained in the ore, are charged through the hopper and chute B. The proportion of fuel to ore will be about one thousand pounds of fuel to a gross ton of ore, the proportion depending on the quality of ore and fuel and the construction of the furnace, the mixed fuel and ores being finally superadded to by fuel or carbonaceous matter C only through auxiliary hoppers and chutes D. The chute B is arranged so that its lower end will descend into the body of the furnace far enough to insure a delivery of the mixed fuel and ores at a point in the furnace where the temperature of the material is at 1,500° Fahrenheit, or slightly in excess of that temperature, and yet not so far into the furnace as to expose the chute to the most intense heat of the furnace, where its parts would be destroyed. In my chute B the mixed fuel and ores, between the point of charging and the point of delivery, are in a state of preparation with a view of preventing the oxidation of the zinc vapor, the moisture contained in the fuel and ore are being expelled by the heat, and the contents of the chute as it approaches the point of delivery being gradually heated to a temperature of about 1,500° Fahrenheit. The same applies to the fuel contained in the auxiliary hoppers D. The effect of this is that the moisture is expelled from the contents of the chutes B and D, and that the mixed fuel and ore and fuel are delivered into the furnace in such a condition and at such a temperature that the zinc vapor on its way out from the furnace is not oxidized.

The following is the method of operation: The furnace being put in operation, when the mixed fuel and ore and also the overlying fuel C have reached a temperature of 1,500° Fahrenheit, the zinc vapor and carbonic acid (generated from the previous reduction of the zinc oxide) from the calcined ores pass through the overlying mass of fuel or carbonaceous matter C, and in so doing the carbonic acid is immediately converted into carbonic oxide, the effect of which is to produce zinc vapor and carbonic oxide, which pass off through conducting-tube E to the condenser F, where the zinc vapor is condensed and the carbonic oxide carried off from the condenser F through pipe G for use, as required.

The advantages of my method are these: cheapness and simplicity in the construction of the apparatus, certainty of operation, due consideration being had to the temperatures, and non-liability to destruction by extreme heat of the parts of the furnace at which the zinc vapor is generated and through which this zinc vapor is conducted to the condenser.

I do not desire to claim, broadly, causing

the zinc and other vapors to pass through a superincumbent charge of carbonaceous matter, nor do I desire to claim any particular form or kind of furnace.

I claim—

The method of reducing the oxide of zinc in ores in cupola-furnaces, consisting in first charging in the furnace the mixed fuel and ore in the proportion substantially as specified; second, charging carbonaceous matter in the furnace independently of the other charge and at one or more independent points above the mixed fuel and ore; third, causing the carbonic acid and zinc vapors to pass through the superincumbent layer of carbonaceous matter; fourth, maintaining a temperature of about 1,400° or 1,500° Fahrenheit, substantially as specified, in the furnace at the point to which the mixed fuel and ore is delivered, and in the superincumbent carbonaceous matter, and, fifth, conducting the resultant zinc vapors and carbonic oxide to a condenser, substantially as specified.

In testimony whereof I have affixed my signature, in presence of two witnesses, this 30th day of March, 1886.

EDWARD WALSH, JR.

Witnesses:

JOSEPH W. CROOKES,

PAUL BAKEWELL.